DOCUMENT RESUME

ED 301 584 TM 012 451

AUTHOR Levy, Gary D.; Meller, Paul J.
TITLE The Structure of Cognitive Categories: Different Structures for Different Domains?
PUB DATE Aug 87
NOTE 30p.; A shorter version of this paper was presented at the Annual Meeting of the American Psychological Association (95th, New York, NY, August 28-September 1, 1987).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Classification; *Cognitive Structures; Higher Education; *Models; *Social Cognition; *Undergraduate Students
IDENTIFIERS *Categorical Processing (Cognition); Cognitive Domain; *Hierarchical Linear Modeling

ABSTRACT

This study was designed to determine whether concepts judged by participants as either prototypically social, non-social, animate, or inanimate would be cognitively structured in a manner consistent with E. Rosch's hierarchical model. During the first experiment, 168 undergraduates generated words to be placed in one of the prototypical categories after being provided with operational definitions of the categories. Results were used to determine prototypical categories. During the second experiment, 197 undergraduates--none of whom participated in the first experiment--generated lists of words related to 12 headings corresponding to the four response categories and eight specific examples generated during the first experiment. Subjects' responses were were rated by four female psychology majors using the a priori operational definitions of the four categories provided for the first experiment. A comparison of the mean number of responses across all four categories was used to construct a mixed hierarchical/linear model of cognitive categorization, since the results fail to confirm either a purely hierarchical or linear model of categorical structuring. The tri-level vertical structure of categories, in descending order of superordinance, consisted of animate, non-social/inanimate, and social. (TJH)

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ED301584

The Structure of Cognitive Categories: Different Structures for Different Domains?

Gary D. Levy and Paul J. Meller

University of Denver Syracuse University

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A shorter version of this paper was presented at the annual meetings of the American Psychological Association; New York, August, 1987. The authors would like to thank D. Bruce Carter, Stephanie Clancy, Jerome B. Dusek, Karen Hooker, William J. Meyer, Chris Montaglione, and Jaipaul L. Roopnarine for their editorial comments and remarks.

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ABSTRACT

Several researchers have suggested that Rosch's hierarchical model of category structure may be appropriate only for domains of natural, physical objects. Moreover, investigators have observed that categories of social information (e.g., parents, females) have differed from natural object categories (e.g., fruit, furniture) in their cognitive structures. The present study was designed to determine if concepts judged by participants as either prototypically social, nonsocial, animate, or inanimate, would be cognitively structured in a manner consistent with Rosch's hierarchical model. The results of the present study failed to confirm either a purely hierarchical or a linear model of categorical structuring. Participants evidenced a hybridized, overlapping network of category structures which possessed qualities from both hierarchical and linear models. Results add to the growing body of research casting doubt on the contention that Rosch's hierarchical model may be completely applicable to social types of information. However, some of the principles found to apply to natural object category structures appear relevant to other domains of information. Implications and future directions for examinations of categorization and social cognition are discussed.

The Structure of Cognitive Categories: Different Models for Different Concepts?

In discussing the psychological principles of categorization, Rosch (1978) describes the human tendency to classify and construct information into meaningful structures in a systematic fashion. Rosch and others maintain that the tendency to categorize information is not an arbitrary or haphazard process but suggest that individuals actively cluster information into discrete categories (e.g., Anderson, 1980; Rosch & Mervis, 1975; Rosch, 1978). These bundles of information were proposed to differ in their degree of overlap with other attributes within a category (i.e., family resemblance) as well as information contained within other categories. Rosch and colleagues state further that natural semantic categories may be understood as a structural network of overlapping, yet discrete, groupings of information. This network is believed to mirror the general correlational nature of environmental information in a fashion which affords the perceiver the ability to efficiently discriminate information, (Rosch & Mervis, 1975).

Within this framework, Rosch distinguished between two types of categories. Basic, subordinate categories were defined as groupings of information in which there is a large amount of internal overlap within a specific category (i.e., family resemblance; Rosch & Mervis, 1975; Lingle, Altom, & Medin, 1984). Further, Lingle, Altom and Medin (1984) suggest that overlap is much more common between

categories of social information. In contrast, superordinate categories were described as higher level structures which have few if any attributes in common with other information within a category (i.e., little overlap). Unlike basic level categories, which organize information at a low level of abstraction, superordinate categories were described as higher order groupings possessing relatively fewer attributes than lower ranking categories.

Employing these definitions, Rosch and colleagues (1975; 1978) have constructed a prototype-based, hierarchical model of category membership for content such as furniture, fruit, vegetables, weapons and clothing. For these types of natural object categories, hierarchical structures appear to be appropriate, and valid, models of categorization (Lingle, et al., 1984). However, researchers have observed that information other than natural objects (e.g., roles, personality prototypes, emotions) does not appear structured in a hierarchical manner (e.g., Cantor & Mischel, 1979; Shaver, Schwartz, Kirkson, & O'Connor, 1987). This issue will be addressed later.

Rosch describes two general principles involved in the formation of cognitive categories. The first principle asserts that categorization of information allows persons to maximize their intake of environmental information while conserving a limited amount of mental abilities. The second principle states that the external real world is a structured set of all information (cf. Gibson, 1969). Despite Rosch's (1978) contention that human categorization of all real-world information follows these general principles, the applicability of her model to different domains of information has

been questioned, (e.g., see Armstrong, Gleitman & Gleitman, 1983; Ashmore, 1981; Deaux, Winton, Crowley & Lewis, 1985; Gleitman, Armstrong, & Gleitman, 1981; Hamilton, 1981; Taylor, 1981). Specifically, Rosch (1978) defines a category as a number of objects that are considered equivalent. Therefore most of her investigations concerning the structures and principles of cognitive categories have revolved around taxonomies of physical objects (e.g., clothing, fruit, furniture, silverware, vehicles, weapons). Although such research has yielded significant findings, it's external validity and applicability to other types of information remain suspect (see Gleitman, et al, 1981).

Consequentially, several researchers (e.g., Armstrong, Gleitman & Gleitman, 1983; Deaux, Winton, Crowley & Lewis, 1985; Gleitman, Armstrong, & Gleitman, 1981; Hamilton, 1981; Taylor, 1981) have suggested that Rosch's traditional hierarchical representation may be appropriate only for domains of natural, physical objects. These investigators have questioned whether identical principles of categorization may be successfully utilized in the examination of other types of content.

Recent investigations in the social cognition literature have attempted to determine if Rosch's prototype-based model of categorization may be applied adequately to social concepts such as personality types (Cantor & Mischel, 1977; 1979), stereotypes (Brewer, Dull & Lui, 1981), emotions (Shaver, et al, 1987), and family roles (Deaux, et. al, 1985). In general, these investigators have found Rosch's prototype-based model of categorization generalize

poorly to social concepts (Deaux, et. al, 1985). Because these attempts to apply Rosch's model to social cognitive domains have failed, the use of strictly hierarchical frameworks of cognitive categorization seems potentially limited to certain types of concepts (e.g., natural object categories). More specifically, hierarchical structures may appropriately describe only those domains where category membership is orthogonal with minimal overlap between categories (Deaux, et al, 1985; Lingle, et al, 1984). It is doubtful that information other than natural object categories and artificially contrived information comply to such restrictions.

A number of investigators (e.g., Deaux, et al, 1985) have questioned the applicability of Rosch's prototype-based, hierarchical model to various real world information, (i.e., not just natural, physical objects). These authors have found that certain non-prototypical, subordinate information elicited similar responses by participants to content thought to be strictly prototypical and superordinate. Though Rosch's second major principle of categorization suggests that all environmental information should be categorized in a hierarchical manner, other researchers have observed that social categories have differed from natural object categories in their cognitive structure (e.g., Deaux, et. al, 1985). These data suggest that perhaps the large mass of environmental information may not be cognitively categorized within a unitary conceptual structure. This being the case, it is conceivable that the cognitive categorizations of concepts differing in relative quality and size, (e.g., animate versus inanimate, social versus nonsocial) require

distinct types of cognitive structures and principles (Gelman & Spelke, 1981).

The purpose of the present study was to explore the structure of qualitatively and quantitatively different types of semantic content (i.e., social, nonsocial, animate, and inanimate information). Specifically, the current study investigated the possible validity of extending Rosch's hierarchical model of categorization to concepts which are not specifically natural and/or physical in character. Similar to other researchers (e.g., Lingle, et al, 1984) we believe the application of natural object classification models to different types of categories may be beneficial and productive, especially when specific assumptions and a priori models of category structure are clearly acknowledged.

Drawing upon prior suggestions (e.g., Deaux, et. al, 1985; Gelman & Spelke, 1981; Lingle, Altom & Medin, 1984), the present investigation was concerned with observing whether the categorical structuring of concepts differing in relative quality and absolute size would be organized hierarchically (i.e., Rosch, 1976), linearly (i.e., Deaux & Lewis, 1984) or both. The present investigation employed established methods of inquiry and statistical analysis in attempting to address these issues, (see Deaux, et al., 1985; Lingle, et al, 1984).

As described in previous research, (e.g., Deaux, et al, 1985; Rosch & Mervis, 1975; Lingle, et al., 1984), attribute counts afford a precise measure for assessing the issue of subordinate versus superordinate ordering. Lingle and colleagues have suggested: 1)

that attributes and relationships among them underlie category structure, and 2) determine how members of categories, and categories themselves, are organized. Specifically, basic level, subordinate categories should prompt participants to generate significantly more responses, (i.e., descriptive adjectives), than should superordinate categories. In addition, the degree of independence between distinct categories serves as a means for determining their relative position in a single hierarchical model. The relative hierarchical ordering of categories may be inferred from the absolute number of attributes generated for each category. Basic level, subordinate categories are characteristically large and overlapping whereas superordinate categories are relatively small in their number of attributes.

There are constraints implicit in the employment of attribute listing techniques and for the most part all techniques for assessing category structures (e.g., multi-dimensional scaling; Shepard, 1980). For example, in requesting participants to list attributes they feel describe particular domains, the domains must be meaningful and commonly used by participants. One way to addressing this constraint is by having participants first produce their own category or prototype headings. An additional constraint entails having developed a priori models of categorical structures embedded within assumptions and intuitions about the structure and utility of such models (Lingle, et al., 1984).

On the basis of these assertions, it was posited that a hierarchical model of categorical structure would be evidenced by a systematic pattern of significant differences in the total number of

attributes generated for each category heading. Conversely, a linear model of categorical structure would be indicated if categories did not significantly differ in the numbers of responses they elicited from participants. Though significant differences between categories would indicate that groupings were distinct in character and order, (i.e., hierarchical), categories which do not significantly differ, (i.e., not independent), support a linear, overlapping model of category structure.

The major impetus of the present study was to determine if concepts judged by participants as prototypically social, nonsocial, animate or inanimate, would be cognitively structured in a hierarchical manner. Our objective is not to argue for one particular model of categorical structure, but to examine the viability of applying a traditional Roschian model to other stimulus domains, when a priori assumptions are clearly discriminated. If Rosch's (1978) contention that all environmental information exists as a structured ensemble of vertical and horizontal dimensions is correct, then participants in the present study should structure the presented information accordingly, (i.e., hierarchically/vertically).

Experiment I

Purpose. Experiment one served as the first phase of a two step process for examining participants' categorization of social, nonsocial, animate, and inanimate content. In this first experiment, stimuli to be used during Experiment II were generated (see Lingle, et al; 1984).

Method

Subjects. One hundred-sixty-eight undergraduate students participated in phase one of the current study. Participation partially fulfilled an experimental requirement of an introductory psychology course.

Procedure. Participants were administered the task in groups during a 60 minute session. At the beginning of the session operational definitions were offered for the terms social, nonsocial, animate, and inanimate (see Table 1). Operational definitions were drawn from prior research (e,g, Gelman & Spelke, 1981; Deaux, et al, 1985) and dictionary definitions (Woolf, 1981). Definitions were presented orally and literally.

Insert Table 1 about here

Following presentation of the operational definitions participants were asked to generate lists of words that they thought were related to each of the following headings: 1) Social/Animate; 2) Social/Inanimate; 3) Nonsocial/Animate; and 4) Nonsocial/Inanimate. Participants were instructed to generate as extensive a set of lists as possible. No criteria were set for minimum or maximum list length. All lists were recorded on lined sheets of paper with one of the four headings at the top of each page.

Therefore, participants' responses and beliefs about what words they thought represented the previously described headings were assessed. Though some of the items participants listed as examples of particular headings might appear strange, they nonetheless were

systematically, and consistently, were proposed by the participants involved. We believe this is a strength in that the stimuli were more ecologically valid and culturally meaningful to participants.

Results

Determination of Prototypical Classes. Similar to previous research (see Deaux et al, 1985; Lingle, et al, 1984), frequency counts of list items were conducted in order to determine which items were most often reported as being related to each heading.

1) Results of the frequency counts revealed one prototypical response class for each of the four headings. These include sexual activity for Social/Animate; mass media for Social/Inanimate; thinking for Nonsocial/Animate; and rocks for Nonsocial/Inanimate.

2) A second set of frequency counts were also performed on each of the response classes to determine the two most frequently cited examples of each class. The twelve words are listed in Table 2.

Insert Table 2 about here

The four general response classes (e.g., social/animate, social/inanimate, nonsocial/animate, nonsocial/inanimate) and eight specific examples (listed in Table 2) were used as stimuli during the second phase of this investigation.

Experiment II

Method

Subjects. One-hundred-ninety-seven undergraduate students enrolled in an introductory psychology course participated. Students who

participated in Experiment I were excluded from the second phase of the investigation. All participants received credit for partial fulfillment of a class requirement.

Procedure. Participants were administered a modified version of the task presented in Experiment I, under similar conditions. During this administration, participants were asked to generate lists of words related to the 12 headings (i.e., the 12 headings included the four response classes and eight specific examples generated in Experiment I). The order of presentation of the 12 headings was randomized across participants. In addition, no information was provided about the relationship of one heading to any other. As in the previous experiment, participants were asked to generate as many items per heading as possible, without specifying a minimum number of responses.

Participants' responses (i.e., lists of words offered by participants as examples of the 12 headings generated in experiment 1) were rated by four female, upper division psychology majors. Each rater was given the a priori operational definitions of social, nonsocial, animate, and inanimate used in experiment one. Raters were asked to determine to which, if any, of the four categories participants' responses belonged. It was emphasized that the four categories were not mutually exclusive and that each response may or may not fit one or more of the categories.[1]

Rater's judgments were scored in terms of subjects' frequencies of responses to each of the four categories. Model building was accomplished by performing paired comparisons between all

combinations of the frequencies of each category. The purpose of these analyses was to allow for comparisons between mean frequencies of each category.

Inter-rater reliability of the assignment to categories was determined by comparing 25% of each rater's profile to a profile scored by one of the experimenters on the same participant. Pearson Product Moment Correlations between the profiles of the experimenter and raters ranged from .81 to .92 with a mean of .875.

To insure adequate inter-rater reliability for category assignment, each rater was required to categorize approximately 25% of all other rater's participants in addition to their own. Pearson Product Moment correlations were computed for each rater's scoring pattern relative to the target rater. A reliability coefficient was computed by averaging across all three rater's correlational coefficients. Reliability coefficients ranged from .81 to .92 (M = .875).

Results

A comparison of the mean number of responses across all four categories was used in building a model of cognitive categorization (Deaux, et al., 1985). The mean number of items reported per category are listed in Table 3.

Insert Table 3 about here

A one-way analysis of variance indicated a significant difference in the number of responses per category (F (7, 764) = 36.14, p

<.0001). Given a significant difference in the number of items per category, a series of planned comparisons were performed to test the hypotheses necessary to build either a linear or hierarchical model of categorization. It was expected that subordinate categories would yield significantly more responses than superordinate categories.

Insert Table 4 about here

Results of the comparisons suggested a mixed hierarchical/linear model. The number of responses within each category relative to all others suggested the relationship between animate, (t (382) = -9.46, p <.0001), inanimate (t (382) =6.26, p <.0001), and nonsocial (t (382) =3.93, p <.0001) categories to be hierarchical. In contrast, the number of social responses did not differ from the other three categories (t (382) =-.73, p <.46).

The actual structure of this mixed model was further delineated using the pairwise comparisons of responses. A review of these results indicated that inanimate and nonsocial categories were not significantly different from each other, suggesting a fused category (t (382) =-1.42, p <.16). This category was significantly different from animate (t (382) =10.29, p <.0001), but not social (t (382) =.62, p <.53) groupings. These results suggested that a linear relationship existed across the nonsocial and inanimate domains, which were subordinate to the animate domain. The results also suggested that the social domain was subordinate to both the non-social/inanimate and animate domains.

Discussion

The results of the present study failed to confirm either a purely traditional hierarchical or linear model of category structure (see Lingle, et al., 1984, for a discussion of traditional models of categorization). Rather than forming either of these distinct categorical orderings, individuals in the present study constructed a hybridized network which possessed qualities from both hierarchical and linear frameworks. The categorical structure observed in the present investigation consisted of three vertical levels. In descending order of superordinance these levels consisted of animate, nonsocial/inanimate, and social. The intermediate nonsocial/inanimate category may be understood as a singular, fused (i.e., overlapping ; Lingle, et al, 1984) category which differs along the horizontal plane (viz Rosch, 1978). Therefore neither of the a priori models of categorical structure (i.e., Rosch's traditional hierarchical framework or a purely linear model) were confirmed within the current investigation.

Though initially these results may appear confusing, closer inspection clarifies the logic of the observed model. The superordinate position of the animate information appear to be based in its informational saliency, relevancy and applicability. Further, Gelman & Spelke (1981) proposed that conceptions of animate information refer mainly to other living humans. Individuals were presumed to employ this characteristic as a salient and efficient dimension on which to structure information. Gelman and Spelke suggested that comprehension of animate objects and their related

properties may develop earlier than a similar understanding of inanimate objects. Similarly, researchers examining script development (e.g., Nelson, 1983) have observed that children initially organize environmental events and information in terms of concrete, action-oriented characteristics. Moreover, investigations of information intake (e.g., Fong & Markus, 1986; Markus, 1977) have consistently observed that individuals incorporate information which is highly self-relative more quickly and efficiently than less relative information. Therefore, the animate category's superordinate position (i.e., high amount of overlap between attributes within the animate category, low degree of correlation with attribute outside of the animate category) may reflect its primacy as a categorizing dimension (Lingle, et al, 1984).

The second component of the present study's categorical model is a combination of attributes defined as inanimate and nonsocial in nature. Again, while this construction and structural position may appear perplexing, closer examination suggested a tenable resolution. Specifically, Rosch suggests that cognitive categories are divided into functional domains and that relationships between certain categories (i.e., family resemblances) may serve to link such domains. In line with these contentions, the inanimate/nonsocial component's structural position was believed to arise from its possession of inanimate contents (i.e., information which is defined in relation to the superordinate animate category). Accordingly, inanimate information's definition-based association with the superordinate animate category was believed to account for its

relative structural position.

Similar to the family resemblance between the animate and inanimate categories, a definition-based relationship existed between the inanimate and nonsocial domains. Because both the inanimate and nonsocial categories were identified in inverted, 'not' terms, they were proposed to share certain common attributes. Though these two semantic categories of information may not directly share a significant amount of common elements, it is suggested that definitions may link them at a conceptual level (see Wittgenstein, 1953). Therefore, unlike the conceptual quality of family resemblance proposedly responsible for the relationship between the superordinate animate and subordinate inanimate categories, the correspondence between the linearly equivalent inanimate and nonsocial domains was suggested to be based more in their similar forms of definition.

The most basic, general, and subordinate category within the present study's hybrid model was the social domain (see Table 2). The subordinate position of this social information may be a result of this information's significant overlap with numerous other elements of information within various categorical groupings (Lingle, et al, 1984). Rosch and colleagues (1975) defined basic level categories as bundles of information which effectively reflect the correlational nature of environmental information. Subordinate categories were described as possessing a large amount of information as a result of their high level of general overlap with other information. However, these category types are not believed to

contain any more 'structure' than the other general domains of information with which they are enmeshed. Thus, the all-encompassing nature of social information would afford its subordinate/basic position. In addition, the abstract nature of social information, particularly in relation to the more concrete animate and inanimate domains, may contribute to its subordinate position and all-encompassing composition.

In summary, the present investigation observed a hybridized, three level model of categorical construction. The superordinate position of the animate category was proposed to reflect this content's cognitive primacy and saliency (Gelman & Spelke, 1981). The relatively subordinate position of inanimate items was believed to result from the inanimate category's conceptual association with the animate domain. Similarly, the fused nature of the inanimate/nonsocial category was suggested to result from 'family resemblance' (Rosch & Mervis, 1975). However, the relationship between these two domains may be based in their similar manners of definition, rather than a sharing of common conceptual elements. Finally, the basic level position of the social domain supported the contention that information within this category was the most overlapping and spontaneously applicable. Given that humans exist in a highly structured social setting, such a notion also seems to be intuitively correct.

Therefore, although Rosch's prototype based category model may apply well to domains of physical objects it may not be entirely applicable for other types of information (viz Deaux, et al., 1985;

Armstrong, et al., 1983; Gleitman, Armstrong, & Gleitman, 1983; Neisser, 1978). The hybridized model observed in the present investigation suggested that categories of qualitatively and quantitatively distinct semantic content may not be structured in an entirely hierarchical manner. The categorical structure of the four examined informational domains possessed both hierarchical/vertical and correlational/horizontal qualities. Therefore, the validity of applying a single categorical framework for all types of environmental information seems questionable.

The results of the present study suggest several meaningful similarities and differences between the domains of social, non-social, animate, and inanimate information. However, it is important to note that we are not arguing for a unitary, monolithic, static structure for the four given stimulus domains. To do so would entail a far too simplified and false vision of category structure. Instead, the present investigation is an attempt to extend the fine research and theory developed within the traditional, Roschian view of category structure to other, more socially-meaningful domains (cf., Deaux, et al, 1985).

In light of such implications, the present study suggests that future examinations of categorization be directed toward identifying the unique cognitive organizations of more specific domains of information. The diversity and malleability of cognitive categories, and of the human cognitive system, prompts us to suggest that it may be more advantageous to attempt to examine smaller categories of information, employing a multi-dimensional approach (Shepard, 1980).

Though such attempts are apparent within the social cognitive literature (e.g., self-schemata, gender-schemata), they are just emerging within cognitive categorization research (e.g., Deaux & Lewis, 1983; Deaux, et al., 1985).

It is probable that such research will lead to the discovery of the properties associated with the cognitive structures of the collection of stimulus domains present. After several different domains of categorical structures have been identified, then a more valid general categorical framework may then be constructed. Perhaps it may be best to begin our investigations at a more specific and microscopic level rather than attempting to discover a unitary structure of all environmental information, (see Armstrong, Gleitman, & Gleitman, 1983; Damon, 1977; Gleitman, Armstrong, & Gleitman, 1983; Hart & Damon, 1983; Turiel, 1978).

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Table 1.

Operational definitions of

animate, inanimate, social, and nonsocial.[1]

Animate: Possessing life, living, to give life.

Inanimate: Not living, unavailable to propel oneself individually, lacking the ability for self-mobilization or movement.

Social: Of or pertaining to human society, or to social relationships.

Nonsocial: Opposite of social, not pertaining to human society, or to social interaction, isolated, independent, lacking mutuality.

[1] Definitions were drawn from Webster's Unabridged Dictionary (Woolf, 1981)

Table 2.

Stimulus Words

1. Sexual Activity
2. Hugging/Kissing
3. Caressing/Fondling
4. Rocks
5. Granite
6. Sandstone
7. Thinking
8. Meditating
9. Dreaming
10. Mass Media
11. Newspaper/Magazine
12. Television/Radio

Table 3. Mean number of responses per category, in descending level of superordinance.[a]

CATEGORY	N	MEAN
SOCIAL	192	83.95
NONSOCIAL	192	77.63
INANIMATE	192	64.95
ANIMATE	192	41.22

[a] Higher means correspond to **subordinate** categories, whereas lower means denote **superordinate** categories.

Table 4. Pairwise comparisons of category frequencies

Category Comparisons	t
Animate versus Inanimate, Social, Nonsocial	-9.46**
Inanimate versus Animate, Social, Nonsocial	6.26**
Social versus Animate, Inanimate, Nonsocial	-.73
Nonsocial versus Animate, Inanimate, Social	3.93**
Animate versus Inanimate/Nonsocial	10.29**
Social versus Animate/Inanimate	-.62
Animate/Inanimate versus Social/Nonsocial	2.77*
Social versus Nonsocial	2.85*
Animate versus Inanimate	9.62**
Nonsocial versus Animate	8.20**
Inanimate versus Social	-4.28**
Nonsocial versus Inanimate	-1.42

** $p < .0001$ * $p < .005$

FOOTNOTE

1. Numerous researchers (e.g., Cantor & Mischel, 1979; Lingle, et al, 1984) have discussed that certain items, particularly social entities, can be viewed as valid members of several categories. Therefore, to constrain participants to list attributes for one, and only one, category seems contrived and invalid.